



NASA STTR 2006 Phase I Solicitation

T7.01 Non-Destructive Evaluation and Structural Health Monitoring

Lead Center: LaRC

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Innovative concepts are being solicited for the development of non-destructive evaluation (NDE) and health-monitoring technologies for vehicles and structures involved in exploration missions. The highest priority is structural health monitoring systems that provide real time in situ diagnostics and evaluation of structural integrity. Emphasis is focused on highly miniaturized, lightweight, compact systems that deliver accurate assessment of structural health. The sensors, data acquisition and analysis systems and associated electronics must perform in high stress and hostile conditions expected on launch vehicles and space environments. Diagnostic systems intended for external inspection of space vehicles and structures will be highly autonomous, remotely operated and preferably non-contacting.

Evaluation sciences include ultrasonics, laser ultrasonics, optics and fiber optics, video optics and laser metrology, thermography, electromagnetics, acoustic emission, X-ray and terahertz radiation. Innovative and novel evaluation approaches are sought for the following materials and structural systems:

- Adhesives and bonded joints, sealants, bearings, coatings, glasses, alloys, laminates, monolithics, material blends, wire insulating materials, and weldments;
- Thermal protection and insulation systems;
- Complex composite and hybrid structural systems; and
- Low-density and high-temperature materials.

Proposals should address the following performance metrics as appropriate:

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- Characterization of material properties;
 - Assessment of effects of defects in materials and structures;
 - Evaluation of mass-loss in materials;
 - Detection of cracks, porosity, foreign material, inclusions, and corrosion;
 - Dis-bonded adhesive joints;
 - Detection of cracks around fasteners such as bolts and rivets;
 - Real-time and in situ monitoring, reporting, and damage characterization for structural durability and life prediction;
 - Repair certification;
 - Environmental sensing;
 - Planetary entry aero-shell validation;
 - Micro-meteor and orbital debris impact location and damage assessment;
 - Electronic system/wiring integrity assessment;
 - Wire insulation integrity and condition (useful life) and arc location for failed insulation;
 - Characterization of load environment on a variety of structural materials and geometries including thermal protection systems and bonded configurations;
 - Identification of loads exceeding design;
 - Monitoring loads for fatigue and preventing overloads;
 - Suppression of acoustic loads;
 - Early detection of damage; and
 - In situ monitoring and control of materials processing.

Measurement and analysis innovations will be characterized by:

- Advanced integrated multi-functional sensor systems;
 - Autonomous inspection approaches;
 - Distributed/embedded sensors;
 - Roaming inspectors;
 - Shape adaptive sensors;
 - Concepts in computational models for signal processing and data interpretation to establish quantitative characterization;
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- Advanced techniques for management and analysis of digital NDE data for health assessment and lifetime prediction; and
 - Biomimetic, and nano-scale sensing approaches for structural health monitoring that meet size and weight limitations for long duration space flight.